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THE AMANITAS OF NORTH CAROLINA

BY H. C. BEARDSLEE

The Amanitas are among the most conspicuous and interesting of our fleshy fungi and for that reason most frequently serve as the starting point for the beginner. In the following paper the attempt has been made to furnish a key and synopsis of the genus which will be serviceable to students of this state. All the species which are listed, with two exceptions have been found near Asheville and will be found generally distributed through this and the surrounding states.

The names used are in the main those in common use. The few changes which have been made, have been determined upon only after carefully comparing our plants with European specimens and after submitting good specimens and life sized photographs to European authorities. Bresadola, Boudier, and Carleton Rea have given much assistance in this work and have placed the author under great obligations.

The genus Amanita may be distinguished among the white spored species by the volva which surrounds the entire plant in its younger state. In the mature plant this is often largely obliter-

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ated, but its remains will usually be seen on the pileus or at the base of the stipe, according to the nature of its development. In some cases the valva is a loose membranous sack, which splits as the pileus develops, and is left as a loose cup at the base of the stipe. In other cases the volva breaks at the margin of the pileus leaving a part adherent to the pileus in the form of irregularwarts, while the basal portion remains adherent to the base of the stipe, either in the form of a sheath with an even margin where it has been ruptured, or in the form of scales.

Species, then, with white spores, a distinct cup at the base of the stipe, or the pileus adorned with superficial warts may be looked for in this genus. The Volvarias wich are rather rare have the same loose cup at the base of the stipe, but will be at once distinguished by the red spore print which will be obtained by placing a cap on white paper,

KEY TO THE GENERA AND SPECIES

Stipe furnished with an annulus. Amanita.

Stipe without an annulus. Amanitopsis.

Amanita.

Volva forming a loose membranous cup at the base of the stipe 1.
Volva forming a distinct marginate sheath adnate to the stipe 3.
Volva not as above. 4.

1. Gills yellow. A. caesarea.
1. Gills white, margin of pileus striate. A. spreta.
1. Gills white, margin ef pileus even. 2.
2. Annulus remaining white. A. phalloides.
2. Annulus becoming sooty black. A. porphyria.
3. Pileus yellow. A. mappa.
3. Pileus white. A. cothurnata.
3. Pileus gray or brownish gray. A. pantherina.
4. Pileus striate on the margin, spores elliptical. A. muscaria and A. russuloides.
4. Pileus striate on the margin, spores subglobose. A. frostiana.
5. Flesh with red stains when wounded. A. rubescens.
5. Not as above. 6.
6. Pileus adorned with erect pointed warts. A. echinocephala.

6. Pileus adorned with thin, adnate, polygonal warts.
A. solitaria.

6. Pileus adorned with thick, large polygonal warts.
A. strobiliformis.

Amanitopsis.

Volva persisting as a membranous cup.	1.
Volva separating into warty scales on the pileus.	2.
Volva pulverent.	A. farinosa.
1. Pileus sulcate striate on the margin.	A. vaginata.
1. Pileus even on the margin.	A. agglutinata.
2. Pileus red.	A. muscaria coccinea.
2. Stipe distinctly bulbous.	A. russuloides.
2. Not as above.	A. strangulata.

AMANITA CAESAREA SCOP.

Pileus 4 to 10 inches broad, smooth, varying from bright scarlet to orange or dingy yellow, distinctly striate on the margin; gills yellow, free; stipe firm, stuffed, usually yellow and flocculose, with a large, persistent annulus. Volva large thick loose, persistent, white. Spores elliptical, 10 to 12 by 5 to 6 mc.

This is easily the finest and most striking of the Amanitas. It is very abundant in Western North Carolina, but is rare farther to the north. It is highly esteemed in Europe as an edible species, but like all the Amanitas should only be used for food when it has been identified beyond all possibility of mistake. It should be remembered that several species of Amanita are highly dangerous.

AMANITA SPRETA PECK.

Pileus 2-6 inches broad, usually gray, or brownish gray, but varying to white. Smooth or nearly so, striate on the margin; gills white, free; stipe cylindrical, not bulbous, stuffed or hollow. Volva loose, free, persistent. Spores 10-12 by 7-8 mc, elliptical.

This is very abundant and also very variable. The common form at Asheville is large and robust, with the margin nearly even, and the pileus brown or dark gray. Other forms are found which are slender and occasionally almost pure white. The more slender forms are much like A. cinerea Pres. which is the European form of this species. One interesting form occurs on our dry hill-

sides which is so distinct that both Peck and Bresadola declare it a distinct species, Careful observations have lead to the conclusion that it is however merely a very distinct variety. I have figured it as A. spreta parva n. var. It may be readily known by its small size. Pileus .5 to 1 inch broad, thin and membranous, soon plane or depressed, deeply sulcate striate on the margin. Stipe slender white with a distant, almost median annulus. Spores as in the type.

AMANITA PHALLOIDES FR.

Pileus 2-5 inches broad, omooth or with a few fragments of the volva, white, yellow, or oliveaceous, often darker on the disk, margin even; gills white, free; stipe white, smooth, bulbous at the base, which is surrounded by the globose, free, membranous volva. Spores globose 9-10 mc.

Common and variable in color. The most common form is pure white and so distinct that it has been separated under the name A. verna. This may be found in our woods in profusion. It may at once be recognized by its pure white pileus, and the globose base of the stipe surrounded by the loose volva. This is the deadly Amanita. It should be remembered that in spite of its attractive appearance it is the most dangerous of our Agarics.

AMANITA PORPHYRIA A. AND S.

Pileus 2-4 inches broad, brownish gray often with a tint of purple, even or slightly striate on the margin, smooth; gills white, slightly adnexed. Stipe stuffed, then hollow, bulbous at the base; volva free; annulus persistent, becoming sooty black. Spores globose, 10-12 mc.

This species has not as yet been detected at Asheville, but is inserted in the conviciion that it will eventually be found here. It has been found by the author in Maine agreeing in every particular with specimens found in Sweden. The peculiar annulus should distinguish it. It collapses upon the stipe and forms a sooty ring which is characteristic.

AMANITA COTHURNATA ATKINSON.

Pileus 2-4 inches broad, white, viscid when moist, covered with

flat, irregular, white warts, striate or tuberculate striate on the margin; gills white, free, broadest at the margin; stipe slender, white, abruptly enlarged into a globose bulbous base. Volva adnate to the base of the stipe, upon which it forms a distinct sheath with a distinct margin. Spores elliptical, 8-10 mc.

Very abundant during the summer. We have used the American name, though with the conviction that this is only a form of A. pantherina. One of the decisive reasons for its separation from A pantherina was that the spores are globose instead of elliptical. This is certainly not true of the fresh plant, though the spores in my dried specimens show a curious habit of becoming distended, and are filled with a large globule which takes the place of the proper contents. The main difference is in the color which is a doubtful character. Typical A. panterina has a dark pileus upon which the white warts are very conspicuous. The curious sheath at the base of the stipe will at once characterize this species.

AMANITA MAPPA FR.

Pileus 2.5 anches broad, yellow or pallid, dry, with flat white or yellow scales from the fragments of the volva, even on the margin; gills white slightly adnexed; stipe stuffed then hollow, white, striate at the apex, with a globose marginate bulb. Spores globose 8 mc.

Found in pine woods, rather rare. This is identical with the the plant which is found in Sweden. It is much like A. phalloides in some regards but has no free volva. The basal portion of the volva is adnate to the bulb and is cut squarely across forming a thick margin at the margin of the bulb.

AMANITA RUBESCENS PERS.

Pileus 2 to 5 inches broad, brown, or red brown, varying to pale or yellow, even or slightly striate on the margin, thickly covered with irregular fragments of the veil, somewhat viscid when moist; gills white, rather narrow, tapering toward the stipe; stipe white, stuffed, becoming hollow, usually bulbous at the base. Flesh of plieus and stipe becoming red when wounded. Spores elliptical 7-9 by 5-6 mc.

Very common. In mature specimens it can at once be recognized by the red stains which will be seen where insects have formed their burrows in the stipe. No trace of the volva will be seen at the base of the stipe in the mature plant.

AMANITA MUSCARIA LINN.

Pileus 3 to 6 inches broad, viscid when moist, thickly covered with the remains of the volva, which breaks up on the pileus in the form of irregular white or yellow warts, varying from bright orange to yellow or pallid, striate on the margin; gills white; stipe white or yellowish, bulbous at the base which is at first covered with scales from the volva. Spores 8-10 by 6-8 mc.

Probably the best known of the Amanitas. The bright orange forms are very beautiful, but the more dingy forms are with us, the most common. It should be carefully distinguished from A. caesarea especially by those who are interested in the Caesars mushroom for food, as it is a dangerous species. The two species may be also identical in color. In other respects they are widely different. A. caesarea has a loose cup shaped volva at the base of the stipe, yellow gills, and a smooth pileus. A. muscaria has no cup shaped volva, white gills, and a warty pileus. No difficulty should be experienced in distinguishing the two species but all doubtful apecimens should be rejected as being possibly the most dangerous A. muscaria.

AMANITA MUSCARIA COCCINEA BEARDSLEE.

Pileus bright scarlet, viscid, striate on the margin, thickly covered with yellow warts. Gills yellow, yellow pulverent on the margin; annulus lacking. This is one of our most striking forms and is so constant that it deserves recognition, especially as it seems to be quite abundant. It may prove to be not distinct from A. gemmata Fr. and A. nitido guttata Paul. though it does not well correspond with the discriptions.

AMANITA ECHINOCEPHALA VITT.

Pileus 3-8 inches broad, pure white to dull olive green, thickly covered with erect pointed scales; gills from pure white or cream to sordid olivaceous, free; stipe solid, colored like the pileus,

mealy or clothed, especially below, with pointed scales, enlarged at the base into a bulb from which a long root like projection is given off. Strong odor of chlorine in old plants. Spores elliptical, 10-12 mc. long.

AMANITA SOLITARIA AULL.

Pileus white or slightly gray, convex, even on the margin, covered wieh thin adnate polygonal warts: gills white, free: stipe solid white, flocculose, somewhat bulbous at the base, bulbs pointed. Spores 10-12 by 7-9 mc. Odor as in the preceding. In woods, less abundant than the preceding species.

AMANITA STOBILIFORMIS PAUL.

Pileus large and firm 3 to 8 inches broad, white or light gray, covered with thick brown polygonal warts, even on the margin; gills white; stipe thick, solid, farinose or scaley, enlarged below into a bulb which is often marginate. Spores 10 to 12 mc elliptical.

I have given here the description of these three species in order to facilitate the study of the group to which they belong. It is necessary to add that the status of this group is more than doubtful, and that there is no agreement among the best authorities in regard to it. The truth in regard to the group seems to be this. It is rather rare in the north. Peck says for example that it is of little consequence to determine whether it is or is not edible on account of its rarity. In the south it is abundant and can be gathered by the bushel. It seems certain that only one who has observed it in comparative rarity should feel sure of the distinctions which are drawn. My observations which are recorded in a large series of photographs are that none of the "characters" are constant enough to be of much value. The shape of the warts and their nature seems to depend largely upon the conditions of development and, in what is clearly the same species, may vary from a thin mealey covering to hard polygonal warts. The shape of the bulb is just as uncertain. In the same species it may be entirely lacking or highly developed, marginate or immarginate, and smooth or scaley. While the dimensions of the spores vary I have been unable to base any sep-

aration on this character. The most striking forms which occur in North Carolina are a form which is dull olive green throughout and gives dark olive spore prints (apparently A. umbella of Cuelet and Bataille's monograph) and the huge attractive form which has been known as Lepiota vittadinii Moret. Upwards of thirty "species" have been described in this group, part attributed to Lepiota and part to Amanita. Most of these are certainly of no value. It is my present opinion that they will all eventually be reduced to synonyms. It is hoped that those who are interested in the subject may secure specimens and photograps of members of the group which are found in their vicinity. It is only by the study of ample material that the matter can be cleared up.

AMANITA RUSSULOIDES PECK.

Pileus 2 to 4 inches broad, pale yellow, viscid when moist, covered at first with white irregular warts, tuberculate, striate on the margin; gills white, free; stipe stuffed, smooth, bulbous. Spores 10 to 11 by 7 to 8 mc. Very abundant in the Asheville region. It is known in Europe as A. junquillea Quel. Amanita vernalis Gilet and A. amici are doubtless but forms of the same species. It is probable also that A. adnata Smith is to be referred here. The form found at Asheville has either no annulus, as is the case with the form figured by Smith or at the most a very rudimentary one. The species is doubtless not rare in our State and will be easily recognized. The pale yellow or straw colored pileus with its striate margin and the rounded bulb at the base of the stipe are characteristic. Specimens from Boudier have been carefully compared with our own material and there can be no doubt of the identity of the two.

AMANITA FROSTIANA PECK.

Pileus 1-2 inches broad, bright yellow or orange, warty from the remains of the volva, even or slightly striate on the margin; gills white, stipe white or yellow, bulbous, spores 8-10 mc, broadly ellipticalor globose. Growing in woods. In appearance this is a small A. muscaria, but the spores are different. It will doubtless be found generally through the the state.

AMANITOPSIS.

This genus differs from Amanita in the absence of an annulus. The division is rather artificial and the fact that some species are found either with or without an annulus makes it of questionable value.

AMANITOPSIS VAGINATA BULL.

Pileus ovate, becoming expanded and plane or depressed, pallid, gray, tan or brown in color, naked or with a few flat fragments of the veil, deeply sulcate, striate on the margin; gills white, free; stipe slender, tapering upward, flocculose; volva membranous, persistent, lax. Spores globose 7 to 10 mc. One of our most abundant and variable species. The loose, cup shaped volva at the base of the stipe, lack of an annulus, and striate margin readily distinguish it.

AMANITOPSIS AGGLUTINATA B. & C.

Pileus firm, convex, even or only striate on the margin, white, slightly colored on the disk and somewhat flocculose scaley; gills white, broad, rounded; stipe not enlarged at the base, equal or tapering upward, stuffed flocculose; volva firm, free, forming a persistent, membranous cup at the base of the stipe. Spores elliptical 11-14 by 5-7 mc.

This is A. volvata Peck and is shown under that name in this country. In Europe it is considered by Bresadola to be the real A. baccata of Fries. Boudier finds it and refers it to A. coccola. Specimens from him are identical with our plant and his figure(Bulletin of the French Mycological Society, Vol. 18, Page 253] represents it perfectly. The description given by Berkeley is however unmistakable and is substantiated by specimens. It seems best to use the first authentic name since A. baccata Fr. must always be an uncertainty. Fries' figure of A. baccata does not seem to represent our plant. A. barlae Quel. is probably another synonym.

AMANITOPSIS STRANGULATA FR.

Pileus 1-4 inches broad, campanulate, becoming expanded and plane or depressed, brown or gray-brown, deeply striate on the

margin, warty, viscid when moist: stipe tapering upward, slightly enlarged at the base, white. Gills not crowded, white, free; volva firm in texture, breaking up into broad felty scales on the pileus and forming a more or less perfect ring which projects like a false annulus from the base of the stipe. Spores globosed 10-12 mc. This is not rare in the mountains af West Virginia and I have included it here although it has not been reported as yet from North Carolina. It comes close to A. vaginata, but seems sufficiently distinct. The curious false annulus is its distinguishing mark.

AMANITOPSIS FARINOSA SCHW.

Pileus 1-2 inches broad, gray or brownish gray, mealy with gray particles which are thickest at the disk, deeply striate on the margin; gills white, free; stipe slender, pallid or gray, bulbous at the base. Spores elliptical or subglobose 6-7 mc long. In open woods along paths. Common.

This dainty species is common in western North Carolina, but is rare farther to the north and is entirely unknown in Europe. The volva is represented by a gray farinose covering which at first covers the entire plant. It is a very distinct and attractive species.

AMANITA SPISSA should be found in our state and it is hoped that collectors will watch for it. It is much like some forms of A. rubescens but the warts on the pileus are gray and the flesh unchangeable. I have observed it in Maine but not at Asheville.

ASHEVILLE, N. C.

INVESTIGATIONS OF THE N. C. GEOLOGICAL AND ECONOMIC SURVEY RELATING TO FORESTRY PROBLEMS ALONG THE NORTH CAROLINA BANKS

BY JOSEPH HYDE PRATT, STATE GEOLOGIST

Problems of considerable interest have recently come up regarding the preservation of the small areas of forests that still remain on a few sections of the Banks along the North Carolina coast and of the reforestation of certain other sections. Conditions along the banks have been studied and, although the investigations have shown that over certain areas it will be impractical to attempt any reforestation or to try and check the progress of the dunes, yet there are certain other areas that should be protected and reforested. The greatest enemy of the areas of forests now existing on the Banks are the dunes and one of the greatest difficulties in the way of checking the progress of the dunes is the cattle, sheep, and hogs that roam over these Banks, devouring the grass, roots, tree sprouts, etc. The survey has been assisted in its work of collecting data regarding the conditions existing along the Banks by Professor Collier Cobb of the University of North Carolina, Mr. I. F. Lewis of Johns Hopkins University, and the U. S. Forest Service. The principal investigation has been on Shackleford Banks, extending from Cape Lookout southwestward about eight miles to Beaufort Inlet and from Cape Hatteras to Hatteras Inlet, a distance of about twelve miles.

Shackleford Bank extends from Cape Lookout southwestward about eight miles to Beaufort Inlet, and is from a half to three-quarters of a mile broad. The whole Bank was, within the memory of the older inhabitants, heavily wooded over iis entire area. Owing, however, to cutting of the timber for firewood and lumber,

the sand of the beach began to drift in on the forest somewhere near 1840. At this time the beach was higher than the forest on the sound side. The beach is described by Mr. Torrey Moore, an inhabitant of the Bank since 1828, as "flattening out on the woods," and so killing the trees. At the present date the eastern end of the Bank is completely "sanded over." The original forest is represented only by several clumps or "islands" of live-oak, which happened to be hardy enough to withstand the drifting sand. Near the western end of the Bank, about two miles of this forest land still remains, though it is rapidly being encroached upon by the advancing sand. Along the seaward side of this strip the beach, originally narrow, has broadened to a quarter of a mile or more, destroying the forest as the sand moved toward the sound. The sand is encroaching on the forest with greater rapidity as the increased breadth of the beach gives more surface for the wind to take up the dry particles and blow them over on the forest.

The forest here is made up chiefly of live-oak and red cedar, with the red mulberry, holly, water beech (Carpinus), and red bay (Persea) occurring commonly. The trees are not large, but are densely massed, and serve to prevent the winter storms from sweeping over the Bank. Cutting of timber was once a common practice but is no longer so, for the reason that the islanders realize that their only protection from storms lies in the forests themselves. The trees are still sometimes used for firewood by the natives.

The inhabitants of the island live on the side of the Bank near the sound, and make their living partly by fishing and partly by gardening. The soil is a deep and mellow loam, suitable for most vegetables grown in this country. The principal plant now under cultivation are figs, tomatoes, sweet and Irish potatoes, cabbage, turnips, beans, peas, watermelons and cantaloups, If the drifting sand is allowed to advance much farther toward the sound, these gardens must be abandoned and the living of the inhabitant must become very precarious.

In the woods on the western end of Shackleford are a considerable number of ponies, cattle, sheep and goats. Sheriff Hancock of Carteret County estimates the numbers from Cape Lookout west

as follows: Three hundred ponies, 500 sheep, 250 cattle, 300 goats. These animals are very destructive, and are rapidly destroying all grass, shrubs, and tree sprouts on the Banks. Commercially they are of little value and a law compelling the people to keep them up would in the end work no hardship on the citizens of the Banks.

A more important, though less immediate, reason for checking the sand drift lies in its effect on the channels and fisheries of the sounds. Where the once wooded Bank has become a sandy desert, the sand blown by the wind has filled in or is filling in the channel of Core Sound. Wherever the woods are still in existence, the deep water extends up to the Bank, but where the woods have been exterminated, the channel near the Bank haf been filled up, being now only one or two feet deep at low water. This in itself is not of great importance for navigation so long as other channels near the mainland can be kept open, However, as the sand drifts in, these will gradually become shallower until, probably within the course of a few decades, the waterway between Bogue and Pamlico sounds will become closed. The effcet of a filling in of the channels would be disastrous to the fishing industry at this point. The enormous stream of mullet and other fish now coming through Core Sound from Pamlico would be diverted to some other outlet, and fishing would cease to be a means of existence to the people of the region.

As an example of the effect on the people of the drifting sand, attention is called to Diamond City, a fishing viliage on the sound side of Shackleford Bank not far from Cape Lookout. When the forest covered this part of the Bank the villagers were prosperous, being sure of a good catch of fish and having productive gardens under cultivation. As the sand came over from the beach, the gardens were first destroyed, then the channels began filling in and the catch of fish fell off. Finally, as the sand spread out more and more, the winter storms began to sweep the Bank more and more completely, until, about 1903, conditions became such that the settlement was broken up, and the inhabitants, about four hundred in all, were compelled to move over to Harker's Island, near the mainland. Now Diamond City is visited only in the fall,

when fishermen take up temporary quarters during part of the fishing season.

To the north of Cape Lookout, the more important forest areas are on Hatteras Island, between the inlet and the cape, one just to the west of the Cape consisting largely of loblolly pine, and another near Hatteras village, composed largely of red cedar, pine and live oak. To the southwest of the inlet there are small scattered areas, containing a good many olive trees. These latter trees make especially good binders in checking the advance of the sand dunes inasmuch as they are able to sprout from their branches, after the main part of the tree has been covered by the sand.

There is one element of the situation which, so far as is known, is different from the conditions where sandbinding work has been instituted, as, for instance, Cape Cod. The winds which cause the sands to move are from the south, blowing pretty constantly during the spring and summer, or growing season. The stronger northeast winds of winter have little effect on the sand. What effect they have consists in blowing the sand back towards the ocean. They are less effective as sand movers than the south winds of summer, partly because they blow less constantly and partly because their force is greatest when the sand is wet from winter rains and not easily to be moved. At any rate, the sand is moving north, carried so chiefly in the summer months, whereas at other points where conditions have been studied, it moves south and west, being blown by winter winds. This condition, which probably obtains along the South Atlantic and Gulf coast, causes the problem to to be presented in a slightly different aspect from that usually considered, and serves to emphasize the desirability of experimental work at this point.

A special report was made for the N. C. Geological and Economic Survey, by Mr. Jay F. Bond of the U. S. Forest Service on the practicability of forest protection on the Banks and how to accomplish it. Mr. Bond's report is as follows:

EXAMINATION OF THE NORTH CAROLINA BANKS

Introduction

The following report is the result of a brief examination of the

banks off the North Carolina coast between Cape Hatteras and the wooded area about six miles west of Beaufort Inlet. This investigation was undertaken by the Forest Service at the request of the State Geologist of North Carolina and was intended only to determine, in a general way, the damage being done by drifting sands on the area examined. If considered necessary, methods of protection against further damage were to be recommended.

The portion of the banks covered by this report is typical of the entire strip and within this area are the only places where active protective measures seem to be required at the present time. A detailed plan for the treatment of these lands is included in this report.

Damage by Shifting Sands

There is abundant evidence, throughout the area examined, of marked changes within a comparatively recent time. Within the recollection of many of the residents, practically the entire banks were forest covered. At present, however, the forests occur only at two points. Immediately west of Cape Hatteras are approximately 2,500 acres covered principally with loblolly pine. Recent estimates of the amount of pine in this stand approximate 20,000,000 feet board measure. Although this figure seems excessive, there is undoubtedly a considerable amount of valuable timber in forest. The trees are of medium size and the lumber of relatively low value, but the accessibility of the stand and the great market for even the poorer grades will make the exploitation of this timber profitable. These lands are held by private owners and the stumpage is controlled by a company which holds an option at $.50 per thousand feet, B, M. This option expires January 1, 1910.

Poor business management has caused a suspension of logging operations, but it is practically certain that lumbering will be resumed in the near future and that a considerable portion of the forest will be removed before the expiration of the option, since it could be renewed only at a much higher rate.

Near the western end of Shackleford Banks are a few hundred acres of forest composed almost entirely of red juniper. This is being exploited in a small way for posts.

The entire area between these points is barren and unproductive. Only at the villages of Hatteras and Ocracoke where the residents maintain small gardens is there any attempt to utilize the land in any way except for the pasturage of a small number of stock. Sand more or less fixed in the form of dome-shaped dunes extends from the ocean to the sounds. The damage here is complete and the improvement of the area as a whole is practically impossible.

There are two localities on the area under discussion where protective measures would prove a decided benefit. At the southeastern and southern part of the woodland near Cape Hatteras the blowing sand is rapidly encroaching upon and destroying the forest while at Beaufort Inlet the surface sand is being blown into Core Sound and, through the destruction of the beach, the width of the inlet is perceptibly increasing. The problem of arresting the damage at these two points is discussed in detail below.

Cape Hatteras Forest

Along the entire southern and western edges of the forest west of Cape Hatteras a considerable area of woodland is being buried and destroyed by blowing sand. As stated above, this timber has a distinct value and, in addition to its value for lumber, the occurrence of the forest makes this locality by far the most desirable residence section of the banks. It is simply a question of a rather limited time, however, when the encroachment of shifting sands, together with destructive logging, will complete the permanent denudation of the area.

The greatest difficulty to be encountered in the treatment of these lands is the fact that they are private property and therefore can scarcely be controlled by legislative action. Apparently nothing can be done, except in an advisory way, to regulate the exploitation of these woods. Fortunately, however, the logging operations were begun at the sound side of the forest remote from the area being encroached upon by the sand and hence the cut-over area will have an opportunity to reforest naturally before the removal of the timber immediately in the lea of the approaching sand dunes. The large proportion of loblolly pine in the stand makes reproduction certain with a minimum of protection. It is

certain, however, that by far the greatest factor in the destruction of the original stand has been careless lumbering.

The destruction resulting from logging has been made permanent by unrestricted grazing, Cattle, sheep, goats and hogs have free range and the damage from these sources cannot be overestimated. Hogs are the greatest menace and a single hog, practically valueless, will root out large areas of sandbinding grasses along the beech. Cattle and sheep complete the destruction by eating the roots of the uprooted grass. The sand thus liberated is carried away by the wind and a "blow-out" results. This blow-out constantly enlarges until the damage becomes general and large areas are affected.

Even if grazing were an important industry on the islands, free range of stock would be fatal to the industry itself as well as to the general productiveness of the lands. The reverse is the fact, however, since competent observers place the total value of all stock between Cape Hatteras and Hatteras Inlet at no more than $1000. The cattle, sheep and horses are in-bred and of minimum value while the hogs are practically worthless since the meat is unfit for consumption, owing to the carrion fish upon which they feed.

It is strongly recommended, therefore, that the Legislature enact suitable laws providing for the fencing of all stock upon this portion of the Banks. This will work no real hardship upon stock owners and, moreover, is an economic necessity if the industry be made profitable. Without such legal protection, all measures for the control of shifting sand such as are described below will be useless. In addition, natural reproduction on the cut-over forest areas cannot be satisfactory since, under present conditions, live oak reproduction, which would otherwise be abundaut, is missing and even pine reproduction is very seriously damaged.

The sand dune area which is encroaching upon the forest lies to the south and east of the woodland. Beginning at a point two miles east of Creed's Hill Life Saving Station, it extends westward four and one-half miles and beyond the wooded area where the sand extends entirely across the banks to the sound. A description of this area and certain recommendations appear below.

Cape Hatteras Sand Dune Area

The moving sand of the dune area between the forest and the ocean has already covered up and destroyed the growth for about one-half mile inland. At the western end of the dune the sand gradually slopes into a low marshy area which extends to Durant's Life Saving Station where a small body of live oak occurs. To the south of this woodland is a long, narrow sand dune and to the west a low wash-flat extends to Hatteras Inlet where there are a few mound-like dunes near the beach.

It is only the dunes immediately south and west of the Cape Hatteras forest which are discussed below, since the dunes further to the west can do practically no damage. Over this entire area the sand is constantly moving in a northeast direction. The surface is practically bare of vegetation and such growth as does spring up from time to time is promptly destroyed by stock.

The direction of the movement of the dunes is undoubtedly influenced by the forest growth which shelters the area from the northerly winds. From the south the winds have uninterrupted sweep and, in consequence, the sand is carried by these winds in a northerly direction. The prevailing winds in the different seasons also have a greater or less influence on the direction in which the sand is carried. During the summer the sand becomes very dry and in this condition is easily carried by the winds which are southerly at this season. In the winter, however, the moist condition of the sand prevents it from being easily carried by the northern winds which prevail. The result is that even where the winds have full sweep in both directions the general movement of the dunes is toward the north.

At the northern end of the sands the dunes terminate abruptly at the edge of the woods. Here there is a high dune rising gradually to a height of about 25 feet. To the leeward the slope of the dune is fully 35°, which seems to be as steep as sand will remain at rest.

The rate at which this dune is advancing inland could not be determined the short time available. It is very evident, however, that the advance is relatively rapid, since there are numerous liv-

ing tops of trees protruding above the sand considerably to the windward of the crest of the leeward dune.

To control and fix these sands will require most careful treatment and an expense entirely disproportionate to the value of the reclaimed land and of the forest lands in the lea. So long as the present conditions in respect to laws and the ownership of the greater part of the area exists protective measures are impossible. In addition to the enactmen of stock laws as recommended above, it is recommended that the state acquire by purchase a strip of the forest land in the lea of the dunes not less than 500 and preferably 1,00 feet wide and extending along the entire area so far as the forest occurs. When this has been done the active measures looking to the control of the sands may be put into effect.

The Fixation of the Sands

The permanent reclamation of the sand waste depends upon two things: (1) Since the source of supply of the sand is inexhaustible, a barrier must be provided near the beach to prevent new supplies of sand which are brought up by the surf from being blown inland. (2) The loose moving sand in the lee of this proposed barrier must be permanently fixed by growing forests.

The success of all work relative to the satisfactory growth of the trees and consequent binding of the sand depends upon the barrier and past experience has established that this barrier is most satisfactory, if it consist of a littoral dune of proper height built up by sand which is arrested by means of mechanical obstructions and held in place by suitable sand-binding grasses. It should be built up parallel to the shore line and not nearer than 100 feet to high water mark.

When the work of fixation is complete, the entire area with the exception of the strip between the barrier dune and the shore line will be covered by a forest. The strip to the windward of the barrier must be held in place by the planting of grass. When the forest has been established, it should be cared for according to usual forest practice.

It will be impossible to establish a forest directly upon the drifting sand either by sowing the seed or by setting out young trees, since the blowing sand either uncovers the seed or buries it too

deeply, while in the case of planted trees, the sand cuts the leaves and bark or buries the plants. It will therefore be necessary to hold the sand in place by some mechanical covering until the trees have developed and formed a natural cover.

The work of fixation is thus divided into two stages: (1) Preliminary, holding the sand in place. (2) Permanent, establishing a forest. Upon the coast strip the work never proceeds beyond the first stage and the maintenance of a grass cover will require constant care.

The Coast Strip and the Barrier Dune.—The coast strip and the barrier dune should be handled in such a way that the surface of the strip may not jeopardize the stability of the dune. It is obvious that the first work is the proper formation of the dune. This is done by rapidly accumulating blowing sand so as to form a long ridge. For this purpose, palisade fences arranged in a double row 6 feet apart are used. Each fence should be made of inch boards 6 inches wide and 5 feet long, driven about two feet into the sand. The tops of the fences should be of equal height and the palings should be four inches apart. Such an arrangement of fences allows the wind to pass through, but reduces its velocity and hence sand is deposited within and on both sides.

As the sand accumulates to the tops of the fences, the palings should be raised and, when the dune has reached a height of 30 feet, sea oats (*Uniola Paniculata*) should be planted 3 feet apart alternating in rows three feet apart, parallel to the crest of the dune. The grass should be planted on both sides of the dune and gradurlly extended toward the windward until the dune attains a fairly permanent form with a gradual slope toward the windward, while on the leeward side the slope will be approximately 30°. The successive steps in the formation of the barrier dune is shown in the series of diagrams accompanying the report (Plate I).

The barrier dune, when completed, will protect the area in the lee but will require constant care tc keep it in proper condition. Every precaution should be taken to prevent a break in the dune and, if such occurs, it must be repaired immediately, since the wind will constantly enlarge the opening. A break may be repaired by the simple expedient of piling brush on the surface of

the blowout and, when the sand has filled in to its former level, by replanting grass as before. The main care should be to maintain a good grass cover over the dune and the coast strip. When the grass becomes thin in one place, plants should be taken from areas where it is thicker than necessary and replanted where required.

Forestation.—The area in the lea of the littoral dune must be planted in forest trees to accomplish permanent fixation. Local conditions and geographical position of the area to be planted are such that proven methods developed in extensive work of this character in Europe may be adapted to this project.

It has been established that the most certain method of securing a forest cover on waste sands is by direct sowing of the seed, provided that suitable species are available for use in the locality and also that the sand be temporarily fixed until the young trees are well established. Upon the formation of the barrier dune the sands in the lee will be comparatively free from the action of the wind, since the dune will protect the area from the southerly wind, while the forest will serve as a windward to the north.

Loblolly pine, a rapid growing species which produces valuable timber, grows throughout the banks. Although, owing to the exposed situation, the qualiiy of timber produced cannot equal that of the forests of the mainland, this tree is by far the most desirable commercial species on the banks.

The proper method of sowing the seed can be determined only by experiment. Two methods are suggested, the second to be used only when it has been clearly demonstrated that the first is not feasable. (1) Sowing the seed directly on the surface. (2) Sowing the seed after the sand has been temporarily fixed by a light covering of brush.

At the western end of the shore dune, on a strip 500 feet wide and extending from the dune to the forest, loblolly pine should be sown at the rate of 12 pounds per acre. The seed should be sown directly on the surfacc of the sand without any preparation of the site. Although there is good reason to count upon favourable results, there are several possible objections to this method. Large quantities of the seed are almost certain to be destroyed by

birds and to guard against this the seed should ke coated with red lead before being sown. Again, wind will blow away some of the seed and in other cases will cover the seed too deeply with sand. It is certain that the action of the wind will be greatly reduced by the littoral dune and the forest, but just how efficient this shelter will be can be determined only by actual experiment.

It is obvious that if the sweep of the wind over the area in the lee of the dune is not reduced to a minimum, the success of planting by direct sowing without previous preparation of the site will be impossible. In such a case the surface of the area to be planted must be covered with a light covering of brush, laid in rows parallel to the barrier dune. Seed should then be sown at the same rate as above among the brush.

Such a method, although more expensive than the first plan, will insure success. The brush should be allowed to remain until the young trees are established and the year following the sowing it should be removed in order not to interfere with the growth of the seedlings.

Brush can be obtained from the nearby forest. Myrtle, red bay, yaupon, or any similar material may be used. Brush cut from the tops and limbs of conifers after lumbering will serve admirably. Such material may be obtaided from recently cut-over areas in the forest.

The forest immediately in the lee of the sands, the purchase of which has been recommended above, should be carefully conserved. Absolutely no cutting should be permitted until the dune forest is firmly established.

The expense of fixing the sands can be only approximated. There was no opportunity in the limited time available to determine the rapidity at which the barrier dune would accumulate. It is obvious therefore that the cost of the dune cannot be determined, since it will vary directly with the the length of time which will elapse before it assumes permanent form. The cost of forestation can, however, be approximated, and will vary from $25 tn $40 per acre, depending upon the method. Seed of the loblolly pine are quoted in the market at $2 per pound but could undoubtedly be secured by contract at a much lower figure.

Material for the palisade needed in the building up of the barrier dune represents a first cost of $900 at present prices and labour for its construction will add at least $500. The cost of maintenance cannot be predicted.

Grass planting on the coast strip and the littoral dune will be expensive and at least $500 must be allowed for this work exclusive of maintenance.

The entire cost of the work of fixation, exclusive of any expense necessary in the acquisition of the lands, will reach at least $40,000.

Advisability of Project.—This report does not aim to outline a policy. It merely suggests a definite plan by which the areas under discussion can be protected and leaves the advisability of the action to the proper authorities.

The work of fixing the sands will serve to accomplish the perpetuity of the only forest remaining on the banks above Beaufort Inlet. If prompt measures, such as outlined above, are not taken, the destruction of the forest is certain. The lands will become a sand waste similar to the larger part of the area of the banks. The cost of the work, however, is large and it is doubted if the value of the property to be protected will equal the cost.

Aside from the intrinsic value of the property, it must be considered that this area supports a considerable population which will be seriously affected should the land become waste. These people are entitled to protection by the State and, although relief could be secured by temporary measures involving less immediate expense,, the method of treatment recommended necessitates the lowest coast consistent with permanent protection.

If, however. the project is undertaken, it is strongly advised that the work of carrying out the details of the general plan advised be entrusted to a competent official and be made a part of his duties.

The Beaufort Inlet Project

The Department of War maintains a series of sand fences on either side of Beaufort Inlet at the entrance to the harbor. These fences are to hold the sand as it is brought to the beach in order to build up the beach and prevent the inlet from increasing in

width. The effect of the blowing sand which might be deposited in the channel is not considered, since the currents will serve to keep the channel clear.

Since the Department of War has made provision for the continuance of this protective work, a further discussion is not essential.

These investigations regarding the preservation of the forests on the Banks of North Cirolina will be continued by Mr. W. W. Ashe, Forester of the Survey, and he will also have supervision of any work that the Survey may undertake to actually protect and perpetuate the forests.

STREPTOCOCCUS INFECTIONS OF THE TONSILS, THEIR DIAGNOSIS AND RELATIONSHIP TO ACUTE ARTICULAR RHEUMATISM.*

BY WM. DEB. MACNIDER.

Perhaps it may seem a rather late day to resurrect such an old and well studied subject as throat infections and their diagnosis. The subject has recently aroused much interest in me from having to deal with two small epidemics of such cases which proved to be of a non-diphtheritic nature and from the complications referable to the joints which several of these cases developed.

Within the past two years I have had the opportunity of studying fifty-eight infections of the tonsils and adjacent soft ports. With but few exceptions these infections have been in males between the ages of 16 and 30. Six were in children between 3 and 8 years of age and four cases occurred in women.

The acute inflammations of the tonsils are usually due to infections by the Staphylococcus or the Bacillus Diphtheriæ. Some organisms of the streptothrix group which are usually present in the mouth and which are non-pathogenic, may perhaps under favorable circumstances become pathogenic and should be classed among the organisms capable of causing acute infections of the throat.

These organisms may be present in pure culture, but frequently a mixed infection exists. In such cases a styphylococcus is often the organism. It is a large coccus, grows luxuriantly on the ordinary culture media add is feebly pathogenic for rabbits when they are inoculated subcutneously.

*Reprinted from The Charlotte Medical Journal, September, 1908.

In the ordinary cases of acute follicular tonsilitis the styphylococcus is the commonist organism found. It can be easily obtained from the white fibrinous plugs in and around the openings of the tonsilar follicles.

Of the fifty-eight cases of throat infection presented in this paper, thirty were subjected to a bacteriological examination and as the other cases which were not so examined developed within a few weeks and in the same locality as those examined, it is not illogical to conclude that they had as their cause the same organism.

Technique.—The bacteriological examination consisted in first making from the exudate covering the tonsils or fauces, two film preparations. One was stained with Loeffler's alkaline mythylene blue and one by Neisser's method. The last method of staining has the advantage of clearly defining the polar bodies, which are to some extent characteristic of the bacillus diphtheriæ.

Secondly with the aid of a cotton swab three blood serum tubes were inoculated from the exudate. These were incubated from twelve to twenty hours and from the colonies which formed film preparations were made and stained by the above methods.

The result of these examinations showed constantly present both in the films made from the throat and from the colonies, an organism having the characteristic chain grouping of streptococcus. Associated with this organism was a diphlococcus of rather large diameters which did not grow well on the ordinary media.

In no instance were there organisms found which at all resembled the bacillus of diphtheria. In the films made from the throat, bacilli were often present which differed from the diphtheria bacilli in that their protoplasm stained uniformly, there was no "barred" appearance, no polar bodies, the organisms were not curved or clubbed but were straight bacilli with rounded ends.

Symptoms.—The symptoms manifested in these cases were those of an acute infection. The onset was sudden with a chill or chilly sensation followed by headache, rather severe backache, a rapid rise of temperature to 103-104 deg. F., a large hightensioned pulse, which compared with the degree of fever was slow, usually about 90-100 per minute.

The tonsils in the majority of cases were only slightly enlarged. The lymphatic glands of the neck were enlarged but this change was not pronounced. The inflammatory reaction of the tonsils consisted in the formation of a grayish white membrane which covered their surface, usually involved both tonsils, and in four cases extended up the anterior pillars of the fauces. The membrane was tough, was removed with difficulty, and after its removal in many instances left behind a raw bleeding surface. In only ten of the fifty-eight cases, was the membranous deposit limited around the follicular openings.

So far as the appearance of the throat was concerned, these cases would have been diagnosed as diphtheritic infections. Such a diagnosis was made in the first four on a purely clinical basis. Their failure to respond to antitoxin treatment led to a bacteriological examination with the demonstration of a streptococcus infection.

A series of such cases, twenty-four in number, have been reported by Prudden of New York in which the streptococcus was the organism present and not the bacillus of diphtheria.

The existence of such cases renders the diagnosis of diphtheria when approached entirely from the clinical side extremely difficult, if not impossible. All cases should be subjected to a bacteriological examination before a diognosis is made.

The second point of interest which developed from the study of this series of cases was the occurrence of symptoms referable to the joints. Many of the patients complained of pain in one or more joints and in a few cases the joints were slightly swollen. Such symptoms lasted but a short time and did not return.

In four of the series the joint symptoms were prominent and persisted. For the sake of brevity a detailed history of the cases will not be given.

Case 1.—A. R. D., male, age 17. The general symptoms were those of an acute infection. The throat examination revealed a grayish membrane covering the right tonsil and sneaking up the right anterior faucal pillar. The lower half of the left tonsil was covered by a similar membrane.

The bacteriological examination demonstrated as a streptococcus infection.

Four days after the patient was first seen the right shoulder joint became swollen, red, tender and painful. The following day the left knee became involved. The joints remained swollen for about one week and gradually returned to the normal. During the time the joints were effected the temperature ranged around 103 degrees., occasionally falling to 101 degrees F., following profuse sweats. At no time was there a leucocytosis.

Case 2—L. A., male, aged 21. This case was very similar to case No 1, with the exception that the changes in the tonsil were those of a follicular tonsilitis. The exudate was more or less confined to the surface immediately around the follicles. From the exudate streptococci were isolated. A few days after the tonsilitis the right shoulder and knee joint become involved.

Case 3.—R. L. W., male age 19. When the patient was first seen he was just recovering from a severe sore throat. His chief complaint was soreness in the left shoulder joint, which he attributed to an injury. Temperature 100 degrees F., pulse 75. The following day the joint was decidedly enlarged and very painful. Five days from this the right ankle joint became swollen and painful, then the left ankle and right shoulder. Within two weeks all the joints had returned to their normal size, except the first joint affected. This joint remained slightly swollen and the movements greatly restricted.

One month from the time the patient was first seen he suddenly complained of intense pain in the left shoulder joint. Within twenty-four hours the joint had increased perceptibly in size and gave evidence of a rapid accumulation of fluid. The joint was opened, liberating a few old tarry looking clots, fresh clots and some pus. Immediately following the operation the patient became profoundly shocked from which condition he failed to rally,

Case 4.—A. H. B., male, aged 19. Mr. B. was seen early in the course of an acute tonsilar infection of streptococcus origin. The local condition had the same characteristics as previous cases. A membranous deposit over both tonsils and extending to both anterior pillars. During the early stage of the infection his temperature remained constantly elevated, ranging between 101 and

104 degrees F. At the end of the first week several points became involved, the swelling and pain presisted for several days and gradually subsided, following the subsidence of the joint changes. The joints at this stage of the infection gave no trouble but severe pain was complained of in the muscles and tendons. This disturbance continued sixteen weeks at the end of which time the patient entered on a tedious convalescence which terminated in complete recovery.

A fifth case recently seen, presented nothing in general different from the cases reported, except the development of a dry pericarditis followed by quite an extensive effusion.

The streptococcus in an organism which varies much in its morphological and biological characteristics as well as in the type of infection which it produces. In some instances it rapidly causes a septicæmia while in other cases it is content to remain a circumscribed infection producing an abcess, or at other times to extend to the adjacent structures without entering the general circulation.

The frequency with which the tonsils act as an avenue for the entrance of an infection has long been recognized. The development of a tonsilitis before or during an attack of acute articular rheumatism, first suggested the possibility of the disease being of microbic and of metabolic origin.

Taking into consideration the ease with which a local infection of the tonsil could become generalized, the frequency with which joint complications follow streptococcus infections of these structures, and lastly, the variety of changes this organism is capable of causing, it is not improbable that a modified streptococcus or or an organism clasely related to it, is the specific cause of acute articular rheumatism.

The specific cause of acute rheumatism,is at the present time, receiving much attention. There practically remains no doubt that the disease is an acute infection and that in many of the cases the tonsils are the portals of entry. The question which is at prescnt under much discussion is whether the disease should be considered as a condition produced by one specific organism, the Diplococcus Rheumaticus of Poynton and Paine. This organ-

ism has been isolated from the synovial fluid of patients with acute rheumatism, has been cultivated on special media where it grows characteristically, and lastly an acute arthritis has been produced by various investigators by giving intravenous injections of the organism to rabbits. This diplococcus is Gram negative, the streptococcus is invariably Gram positive.

The question of the specific nature of acute rheumatism has been well summed up by Cole of the Johns Hopkins Medical School. His views are certainly conservative. They are as follows:

"I greatly fear we are not as yet in a position to make any positive statements as to the etiology of this disease. It seems to me that there are at least three possibilities. First, that acute articular rheumatism is a definite, acute, specific infectious disease, the cause of which we do not know, and that the cocci which have been isolated were secondary invaders. Second, that there is no such specific disease as acute articular rheumatism, but that the cases grouped under this term are those of a mild and moderately severe case of general streptococcus infection, in which the joints and heart are generally involved. Third, that acute articular rheumatism is due to a specific form of streptococcus, which at present we have no accurate method of distinguishing from Streptococcus Pyogenes, but which, owing to the specific character of the lesions induced in man, must possess special characteristics."

Lastly, in regard to the treatments of these cases a point of interest develops. It is well known that the salicylates have a more or less specific influence in cases of acute rheumatism. In all of these cases of streptococcus infections of the tonsils the salicylates were of great service in relieving the subjective symptoms. This relief might be produced through the general action of the salicylates on the nervous and circulatory systems, or, on the other hand, it might be explained through a germicidal action of the salicylates on the specific cause of the disease.

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THE "PINCH-EFFECT" IN UNIDIRECTIONAL ELECTRIC SPARKS.[1]

BY ANDREW H. PATTERSON.

Prof. Nipher has recently[2] described some interesting experiments on momentum effects in electric discharge, and writes as follows concerning the undirectional sparks obtained by the insertion into the circuit of strips of cloth moistened with a saline solution: "....the sparks are large and brilliant at the negative end in both positive and negative lines, and thin out towards the positive end. The negative terminals are large spheres of about 10 cm. diameter. The positive terminals are small knobs, of 1 cm. diameter. *While on the large sphere the electrons repel each other. But when they start into motion across the spark-gap, they attract each other electromagnetically.* This appears to be the reason why the spark thins out as the electrons proceed in their motion across the spark-gap. The italics are mine.

According to theory, two like charges repelling each other when at rest, begin to develop an electromagnetic attraction for each other as soon as they are put in motion in the same direction. But this attraction does not become equal to the electrostatic repulsion until the charges move with the velocity of light. This used to seem very puzzeling to me, for I reasoned as follows:— Imagine a positively charged hopper filled with steel balls, which continually dropped into two parallel inclined glass troughs. As the motion of the charged balls is constantly accelerated, the electromagnetic attraction which they exert on the charged balls

[1]Reprinted from Science, vol. 29, p. 731, Jan. 1, 1909.
[2]Science, vol. 28, p. 805, Dec. 4, 1908.

in the other trough grows larger and larger until the velocity is that of light, when the streams of balls in the two troughs are exerting zero fource on each other, (for their electrostatic repulsion is exactly balanced by their electromagnetic attraction), and yet they are said to be behaving like electric currents. Why, then, do parallel currents actually attract each other? No one supposes that a current in a wire travels *faster* than light. Some years ago in Cambridge I asked Prof. (now Sir) J. J. Thomson about it, and he replied that my analogy was all right, except that according to the electron theory the glass trough should have a metal covering outside, which is *positively* charged, the hopper should be *negatively* charged, and the charge on a unit's length of the trough should equal the sum of the negative charges on the balls contained in that length. Then, the analogy, while crude, would be comrlete:—the steel balls would represent electrons, and the current in the ordinary sense would flow up the trough instead of down. The charge on the covering of the trough would represent the the charges on the positive atoms in a conductor. Under these circumstances it is easy to see that attraction between the troughs would ensue as soon as the balls began to move. Prof. Nipher's explanation, therefore, would seem to be valid only on the supposition that the positive ions in the line of the disruptive discharge (which are dashing towards the negative terminal) would take the place of the metal-covered trough in my analogy, thus rendering the electromagnetic attraction of the moving electrons effective in drawing them together in a column which continually thins out towards the positive terminal. If this be true, the effect ought to be rendered more intense because of this consideration:—the analogy would then be that of the trough itself (carrying a a positive charge) *moving in the opposite direction to the motion of the steel balls*, thus making the relative velocity of the balls greater and the attraction more intense.

But there is another way of looking at it which may be more natural. The negative terminal is a large sphere 10 cm. in diameter, while the positive terminal is but 1 cm. in diameter. The lines of force are therefore strongly convergent frem the negative to the positive sphere, somewhat like the ropes from the gas bag of a

balloon to the much smaller basket beneath, and electrons sliding down these lines (along their negative direction, of course) would naturally arrange themselves in a column larger at the negative end, especially as these lines are themselves falling towards the center line of the discharge. In this case would not the phenomenon simply show the pinch effect in gaseous discharge?

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THE RECENT BALTIMORE MEETINGS OF SCIENTIFIC SOCIETIES

ZOOLOGY

Both the American Society of Zoologists and Section F (Zoology) of the American Association held meetings. Thirty three papers were read before section F and fifty nine papers before the Society of Zoologists. The meeting like all those of recent years in America gave ample evidence of the strength of the analytic tendency. Striking discoveries in morphology whether of adult forms, larvae, or embryos, or of tissues, or of cell groupings and movements during embryonic life, continue to be few. The relationships of animals (phylogenetic classification) have for the time being almost dropped from the list of subjects discussed. Keen interest is however manifested in morphological data that can be interpreted as throwing light on the physiology of development. Prominent in this connection were papers by E. B. Wilson and T. H. Morgan on sex determination and the nuclear constitution of the sperm in certain insects. These investigators produced new facts as to chromosome arrangement which lend support to the hypothesis that sex is determined in the individual germ cell by the presence of a male-producing or female-producing chromosome.

Underlying this special question of sex determination is the general question as to the nature of the whole process of differentiation during development. As bearing upon this question E. G. Conklin presented the results of an experimental study of egg organization in ascidians and mollusks. Earlier studies led him to the conclusion that the egg cytoplasm in these forms becomes differentiated into substances ("organ-forming substances") that have fixed and different potentialities, such for instance as a cytoplasmic area that necessarily develops into the notochord. Conklin employing the centrifuge alters the arrangement of sub-

stances in the egg and obtains larvae with correspondingly misplaced organs. Thus experiment confirms his earlier conclusion.

In cases like the preceding, differentiation even when interfered with is not directly affected by external factors but is clearly the result of internal agencies. A capital instance, as it would seem, of the direct influence of an external agency on the differentiating embryo was discussed by C. R. Stockard, who finds that if the fertilized eggs of the teleost *Fundulus* are treated with a trace of magnesium chloride cyclopean monsters regularly develop in considerable number. Another interesting paper dealing with vertebrate monsters and the causes of their production was presented by H. H. Wilder who sharply separates mere malformations from bilaterally symmetrical monsters which develop in an orderly fashion, as Wilder thinks, in obedience to a mechanism of control inherent in the germ.

The numerous experiments of recent years on hybridization and artificial parthenogenesis in the echinoderms have made it clear that before we can deduce with certainty the influence of the two sexes in determining the characters of the resultant embryo and larva, we must know more about embryonic variability in the species experimented upon. D. H. Tennent has made a good step in this direction in his mapping out of the embryonic variability in the Beaufort echinoids which he has been using for experimental work.

A considerable number of papers that would collectively fall under the rubric of experimental evolution dealt with phenomena of inheritance as disclosed in the breeding of poultry, pigeons, rats, and insects. Some of the results fit in very well with the hypothesis of unit.characters and Mendelism, but W. L. Tower stated that he had been unable to make use of Mendel's ideas in his experiments, since in the offspring from his crossed forms the parental characters might or might not appear in the Mendelian ratios. C. B. Davenport voiced the widely entertained opinion that even in apparently contradictory cases, such as those presented by Tower, Mendelism gives a clue that will aid in unravelling the tangle of factors.

Good contributions to systematic zoology and geographical distribution were not lacking. C. Hart Merriam gave an account of the

work of the U. S. Biological Survey. There were papers on cestodes by Edwin Linton, on bryozoa by R. C. Osburn, on isopods by Miss Harriet Richardson. The evolution of species and races in certain land shells of the Society Islands was discussed by H. E. Crampton who has made a careful study, during several visits to the islands, of the local distribution of the different forms.

Mention should be made of a number of papers by H. S. Jennings, L. L. Woodruff, and others on the behavior of protozoa in respect to conjugation and in response to various stimuli. The instinctive actions of higher forms, too, received attention, especially in one of F. H. Herrick's studies of bird behavior (cuckoo) in G. A. Drew's account of the reproductive processes of the squid. Finally there were papers dealing with the analysis of physiological processes in the adult. Among these may be mentioned A. G. Mayer's fine study of the cause of rhythmical pulsation in the scyphomedusae. H. V. WILSON.

CHEMISTRY

The 39th general meeting of the American Chemical Society was held in Baltimore Tuesday, December 29, 1908 to Friday January 1, 1909 in conjunction with the meeting of the American Association for the Advancement of Science. The attendance was the largest in the history of the society, partly due to the favorable meeting place and partly due to the fact that recent large accessions to the membership have made it one of the largest chemical societies in the world. The last report gave an enrollment of 4008. The great increase in membership during the last year was primarily due to the establishment of the Industrial Division and the promise of a journal devoted to technical chemistry. This "Journal of Industrial and Engineering Chemistry" has now made its appearance. Two years ago the society began the publication of "Chemical Abstracts", a semi-monthly periodical, the most complete chemical abstract journal published. Three journals are now issued by the society. The success of the Industrial Division led to the organization at Baltimore of the Division of Physical and Inorganic Chemistry, Division of Organic Chemistry and the Division of Fertilizer Chemistry.

By far the larger part of the papers are given in sectional meetings but at Baltimore more than the usual number of general meetings was held, thus bringing all sorts of chemists together more than ordinarily. This general mixing was further increased by the fact that the best place to obtain the noon lunches was at the Woman's College where the meetings were held. In the morning of the first day the society listened to the following addresses: "The Untilled Field of Chemistry" by A. D. Little, Chairman Division Industrial Chemists and Chemical Engineers, "The Use and Abuse of the Ionic Theory" by G. N. Lewis, Chairman of Physical Chemistry Section; "The Work of Werner on the Constitution of Inorganic Compounds" by Charles H. Herty, Chairman of Inorganic Chemistry Section. The afternoon was given exclusively to the meeting of the new Section of Chemical Education, four papers being presented as follows: "Science Teaching as a Career" by H. P. Talbot, Chairman of this section; "The Efficiency and Deficiencies of the College Trained Chemist when Tested in the Technical Field" by William H. Nichols; "To What Extent Should College Training Confer Practical Efficiency along Technical Lines" by L. M. Dennis; "The Attitude of Technical Institutions to Post Graduate Study" by William McMurtrie.

In the evening at the Hotel Belvedere William Sinon gave an illustrated lecture on the "Lumiere Process of Color Phography." This was followed by a complimentary smoker. Sectional meetings were held Wednesday forenoon and on subsequent days. Agricultural and Food Chemistry Section, H.J. Wheeler, Chairman, 21 papers; Biological Chemistry Section, J. J. Abel, Chairman, 16 papers; Division of Industrial Chemists and Chemical Engineers, A. D. Little, Chairman, 26 papers; Fertilizer Chemistry Section, F. B. Carpenter, Chairman, 10 papers; Pharmaceutical Chemistry Section, Edward Kremers, Chairman, 5 papers; Inorganic Chemistry Section, Charles H. Herty, Chairman, 17 papers; Organic Chemistry Section, S. F. Acree, Chairman, 29 papers: Physical Chemistry Section, Gilbert N. Lewis, Chairman, 31 papers. Wednesday afternoon was devoted to two excursions, one to the U. S. Naval Academy at Annapolis and the other to Sharp and Dohme, pharmaceutical chemists. In the evening at the Girl's

Latin School Prof. M. T. Bogert, President of the Society delivered an address on "The Function of Chemistry in the Conservation of Our Natural Resources." It was shown that chemistry does play and will play a more important role in the conservation of our resourses by developing better methods of working up the natural resources and new methods of utilizing waste products.

Thursday forenoon at the business meeting resolutions of respect on the death of Wolcott Gibbs were passed. The following addresses were given at this time: "The Future of Agricultural Chemistry" by H. J. Wheeler, "The Quantitative Study of Organic Reactions" by S. F. Acree, "The Classification of Carbon Compounds" by Edward Kremers. In the evening a subscription dinner was given at the Hotel Belvedere. It was an unusual success, not only in point of cuisine but in the great enthusiasm and jollity that was manifest throughout the evening. On Friday adjourned meetings of the sections were held and a trip was made to the Maryland Steel Company's works at Sparrow's Point. William R. Whitney, Director of the Research Laboratories of the General Electric Co. was elected president for the coming year. The following were elected Councilors-at-Large: W. Lash Miller, Chas. H. Herty, S. W. Parr, W. H. Walker. The summer meeting of 1909 will be held at Detroit and the winter meeting at Boston.

ALVIN S. WHEELER.

PHYSICS

The attendance at the meetings of Section B was larger than ever before, the Physics lecture room at the Johns Hopkins University being comfortably filled at almost every session. No striking discoveries were reported, and there was not the enthusiasm which greeted for example, the papers of Rutherford at earlier meetings, but the interest was sustained throughout, and the discussions were incisive and entertaining. The noticeable feature was that while all the speakers seemed to realize that the electron theory is yet simply a working hypothesis, still the language and the conceptions of that theory were constantly used to explain phenomena described in various papers. The listener could not fail to discern a quiet note of confidence in the substantial accur-

acy of that theory. Another point of interest was that terrestial and cosmical physics was brought into prominence as never before at these meetings. Quite a number of papers were presented dealing with various phases of this growing branch of physical science, and Dr. L. A. Bauer, Director of the Department of Terrestial Magnetism of the Carnegie Institution, took a prominent part in the discussions, and indeed was elected Vice-President of Section B for next year. Many papers dealt with attempts to "try out" many phases of the Electron Theory experimentally, in some cases with negative, in other cases with positive results. Among the more inportant papers should be mentioned those on "The extension of the Balmer series of lines in the Sodium Spectrum," by Prof. R. W. Wood, of Johns Hopkins University; "The Optical Properties of Films of Magnetic Metals," by Prof. C. A. Skinner, University of Nebraska; and "Solar Vortices and Magnetic Fields," by Prof G. E. Hale, of Mount Wilson Observatory, Cal.

The Physicists' Dinner, a new departure, at the Country Club near Baltimore, was a decided success, and will doubtless be a regular part of the program in the future. It was decided at this dinner to cable the congratulations of those present to Prof. Ernest Rutherford, a former member of the American Physical Society, on receiving the Nobel prize in Chemistry for last year.

A. H. PATTERSON.

GEOLOGY

The twenty-first annual meeting of the Geological Society of America was held in the geological building of Johns Hopkins University, Tuesday to Thursday, 29 to 31 December, 1908. The morning and afternoon sessions were devoted to the transaction of business and the reading and discussion of original papers. The formal address by President Samuel Calvin on "The Latest Phase of the Pleistocene Problem in Iowa" was delivered Tuesday enening in the main lecture room, followed by a smoker and social hour in the laboratory. Wednesday evening the annual dinner of the Society took place at the Hotel Rennert, President Calvin acted as toastmaster. Over one hundred geologists were present. The guest of honor was Professor Albrecht Penck, of the University of Berlin. Informal talks were make by Professor

Penck, Professor Chamberlain, President Van Hise, Professor Stevenson, Professor Fairchild, Dr. W. B. Clark, and others. Dr. Gilbert spoke feelingly of his life spent in geology. Dr. G. O. Smith told of the work of the federal survey, and Dr. Brock spoke in behalf of the Canadian Survey.

Seventy two papers were listed on the programme, of which about three-fourths were read. They were arranged in the following groups: Physical and Structual, Glacial, Stratigraphic, Areal, Paleontologic, Petrologic, Physiographic, Cartographic, Economic. By invitation of the council Professor Penck delivered a lecture on interglacial epochs Wednesday morning. This great geograper and glacial geologist in the brief time at his disposal summed up the evidence, as exhibited in the Alps and in North America, bearing upon the lapses of time between the different ice invasions.

"Some Distinctions between Marine and Terrestial Conglomerates", by Joseph Barrell, followed the same line which this author has pursued for some years, and showed his usual painstaking research. Professor Chamberlain's paper, "Diastrophism of the Ultimate Basis of Correlation", was appreciated by all. The sensation of the meeting came when Frank B. Taylor in his paper, "The Bearing of the Tertiary Mountain Belt upon the Origin of the Earth's Plan", suggested the possibility of the earth having captured the moon in late geological time, thus accounting for the earth's polar shortening. The papers by Fairchild on the recession of the ice in New York, elicited much comment from Brigham and others, and it seemed difficult for the glaciologist to agree upon details. Dr. W. B. Clark spoke of the results of the invistigation of the coastal plain formations along the Atlantic coast. Of interest to North Carolinians were the papers by E. W. Berry on "The Geologic Relations of the Cretaceous Floras of Virginia and North Carolina", and by S. L. Miller on "Erosion Intervals in the Tertiary of North Carolina and Their Bearing upon the Distribution of the Formations". Dr. E. O. Hovey displayed some very fine views of Mont Pelé and the Soufrière taken last summer, and pointed out recent changes in the two volcanoes.

The paper most eagerly awaited by stratigraphers and general geologists entitled, "Revision of the Paleozoic Systems in North

America", by E. O. Ulrich was read to a crowded audience. Dr. Ulrich has spent many years during his connection with the U. S. Geological Survey in gathering first hand knowledge of the Paleozoic formations, and his conclusions are the ripe fruit of a mind long trained in field observation and paleontology. Such vague terms as Cambro-Ordovician and Devono-Mississippian are decried by him as savoring of ignorance, and the attempt is made to show that definite boundaries can be discovered by careful field search and close correlation. "The proposed classification is based primarily on crustal movements, diastrophism, the succession of which is determined by the faunal evidence. The occurance of such movements is determined, aside from plain physical evidence, primarily by mutations in the faunas, especially by the introduction of new faunal elements and facies, etc." One of the proposed changes is the insertion of a new system, the Ozarkian, so-called for its development in Missouri and Arkansas, between the Cambrian and Ordovician systems. This system occurs also along the Appalachian Valley from New York to Alabama, and is separated from both Cambrian and Ordovician by unconformities. Another change consists in placing the Meramec and Chester groups of the Mississippian in the system, the Tennesseean, between the Mississippian and the Pennsylvanian.

The meeting of the Society disbanded with the offering of a formal vote of thanks to Dr. W. B. Clark and his colleagues for the entertainment and courtesy extended to all visiting geologists.

H. N. EATON.

BOTANY

The recent meetings in Baltimore of the botanists of America were the largest, most interesting, and most successfully conducted of any ever held in this country. The botanical societies that came together there were Section G. of the American Association for the Advancement of Science, The Botanical Society of America, The Sullivant Moss Society, The Wild Flower Preservation Society, and The American Nature Study Society (which is interested in the teaching of botany).

The Secretaries of Section G. and of the Botanical Society of

America were so successful in arranging their sessions as to avoid any conflict of programs, but it was found necessary to segregate the papers on fungi into a separate program. This withdrawal of the fungologists into sessions of their own marks another step in the process of specialization that characterizes the advance of all our sciences. The economic importance of the fungi in producing diseases of plants and animals has naturally attracted much attention to them, and papers on their structure and habits are becoming more numerous with each succeeding year.

Attractive as the newer fields of botanical research undoubtedly are, they have not led to a decline of interest in the subjects of morphology and classification. Such papers as Chrysler's "On the nature of the fertile spike in the Ophioglossaceae" which throw new light on relationships, and as Shattuck's on the "Origin of Heterospory in Marsilea", a good piece of work on experimental morphology, never fail to attract attention.

During the last few years the most notable development in our knowledge of morphology has been along the line of vascular anatomy. In the words of Prof. John M. Coulter "Phylogenetic vascular anatomy was developed at an auspicious time, for phylogeny based upon reproductive structures was beginning to waver. Wider research had begun to dissipate rigid categories into mists, and especially had expermental morphology begun to play havoc. The whole situation has been steadied, at least momentarily, by the recent development of vascular anatomy, including as it does the enormously important ancient history of the vascular groups."

Prof. J. C. BOSE, a hindoo, who was here on a commission from the government of India, gave an address on the little known subject of "Electrical response in plants" that attracted much attention.

From the program it was obvious that the study of ecology* is gaining ground. A symposium on the subject was held by the Botanical Society of America in which papers were given by

*Students of Dr. W. K. Brooks will remember how much he disliked that word, claiming that it was not needed, its meaning being entirely covered by the word "biology".

Cowles, Livingston, Shaw Spalding, and Transeau. Expressions in these papers indicated that the long dominent idea that all structure and activities of a plant must have some useful purpose or express some adaptation is fast being replaced by one that admits the possibility of useless structures. It is a relief, as Cowles says, not to be compelled to find adaptations where none exists.

Interest in the factors of evolution and the laws of inheritance is still most active, and evidence is being sought by experiments in many directions. The mutation theory and the laws of Mendel still focus the attention of the students of evolution; but it seems evident that we are still far from the time when these highly complex phenomena may be expressed in simple laws.

To commemorate the birth of Charles Darwin one hnndred years ago a memorial session was held by the Botanical Society of America. The following addresses were made:

"General sketch and estimate of Darwin's work on cross-pollination in plants," by William Trelease. "Estimate of Darwin's work on movement of plants," by H. M. Richards. "Darwin's influence on plant ecology and plant geography," by F. E. Clements. A Darwin centenary memorial was also held by the American Association for the Advancement of Science, together with the American Society of Naturalists, all sciences participating. The two addresses given by botanists were as follows: "The Theory of Natural Selection from the standpoint of botany," by John. M. Coulter; "The Direct Effect of Environment," by Daniel T. MacDougal. From the tenor of these addresses it was evident that the fame of Darwin is in no wise on the decline. His influence on science, philosophy, life is beyond all estimate. Fifty years have passed since the publication of "The Origin of Species," years unparalled for progress in the history of the world; and it was the momentum of Darwin's thought that initiated that progress and that sustained it in its course. Since that eventful year of 1859 much new knowledge has been acquired and points of view have changed, new theories have been proposed and old ones modified; but through bitter assault and turmoil and testing the foundations that Darwin built

have remained unshaken, and of all the great names that make memorable the 19th century his, at least, is secure:

> "Nothing is here for tears, nothing to wail
> Or knock the breast; no weakness, no contempt,
> Dispraise, or blame; nothing but well and fair,
> And what may quiet us in a" life "so noble."
>
> W. C. COKER.

PLATE I.

Fig 1

Fig. 3

Fig. 2

Fig. 4

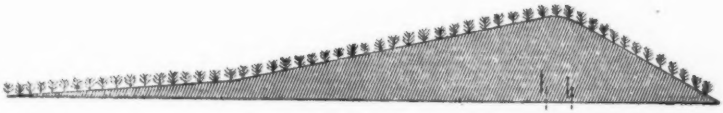

Fig. 5

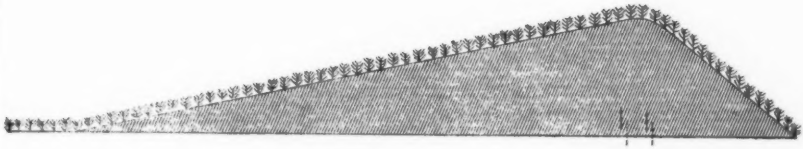

Fig. 6.

DIAGRAMS EXPLAINING PROGRESSIVE STEPS IN THE FORMATION OF BARRIER DUNE

When the dune has assumed the form illustrated by Fig. 4, grass is planted, and by extending the area planted towards the shore (to the left) the subsequent form of the dune is influenced.

North Carolina Geological Survey.